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Abstract

CRITICAL PARAMETERS OF URANIUM SALT AQUEOUS SOLUTIONS AND NUCLEAR SAFETY

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Experimental and theoretical investigations on critical parameters of uranium salt aqueous solutions with 90,10 or 5 per cent enrichment are described. There investigations were carried out for determination of nuclear safety conditions and for studies of homogeneous reactor physics. Critical volumes of the solutions defermined at various uranium concentrations in the range of 30-450 g/l.

Extrapolation lenghths and effective additions of various reflectors were determined during experiments.

The experimental results obtained for cylinder and rectangular cores by transformation of geometrical parameter using the extrapolation lenghth and effective addition of light water reflector, were recalculated for cores having shapes of a sphere, infinite cylinder and infinite flat layer.

These values were compared with the results of experiments, conducted on cores having the shape of a sphere and infinite cylinder.

The report includes the results of experiments for determination of critical size dependence on per cent content of steel and nitric acid in the core, as well as the results of experiments for deformination the effect of various compound reflectors on critical parameters.

The theoretical analysis of experimental data was carried out in two ways: by solution of multigroup equations for a reactor in P_1 and P_3- approximations and by empirical nuclei method. An idealized problem on water moderated reactor was solved for testing

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the validity of various approximations. The calculation method and the cross-sections used are shown to give the results which are in good agreement with experiments.

On the basis of this analysis the material buckling and extrapolation boundary of water moderated reactors are derived.

The report includes the results of experiments on determination of effectiveness of absorbing rods of different shapes and composition in homogeneous uranium-water reactors with uranyl nitrate solutions.

The effectiveness of regular absorbing rod lattices with various pitches and uranium concentration in the solution was also determined.

Multigroup calculations on determination of effectiveness of the central cylindrical rod of boron carbide with steel canning are reported.

The calculation method presented in the report for determination of effectiveness of regular absorbing rod lattice in the reactor consists of homogenization of the core with absorbing rods.

The effectiveness and the homogenization parameters of the infinite absorbing rod lattices in homogeneous multiplying media are determined with the account of the detail energy dependence on absorption and scattering cross-sections of rod material.

The effectiveness and cross-sections of infinite lattice rods are derived in a diffision age approximation on the basis of the analysis of an equivalent cell in the one-dimensional geometry.

The results of the calculation of the effective absorption cross-sections of the absorbing rod in a cell were used for a multigroup calculation of reactors with rod lattices.

Results of experimental investigation and calculations on neutron interaction of subcritical assemblies with aqueous uranyl nitrate solutions are described.

A certain number of experiments were made with 2,3,4 and 5

cylinders (d = 30 cm) and parallepipeds placed on the same plane but at different spaces.

The results of the experiments with 6-liters wessels placed in a flat and spatial lattices on different spaces are also described.

The authors describe the calculation method of interaction of fissible systems based on determination of "effective" sizes for such cylinders which make up the whole system.

The results of the experiments are compared with those of calculations performed by the "effective size" method.

The review and comparision of some existing methods of interaction calculation are given.